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10/593,098	10/24/2006	Susumu Kitagawa	1034228-000002	7829
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EXAMINER BOYLE, ROBERT C				
ART UNIT		PAPER NUMBER		
1796				
NOTIFICATION DATE		DELIVERY MODE		
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ADIPFDD@bipc.com

### Office Action Summary

**Application No.**

10/593,098

**Applicant(s)**

KITAGAWA ET AL.

**Examiner**

ROBERT C. BOYLE

**Art Unit**

1796

**Period for Reply** -- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 29 December 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-29 and 35-41 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-29 and 35-41 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 15 September 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB08)
- 4) ☐ Interview Summary (PTO-413)
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_
- Paper No(s)/Mail Date \_\_\_\_\_

### **DETAILED ACTION**

#### ***Response to Amendment***

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
2. Any rejections stated in the previous Office Action and not repeated below are withdrawn.
3. Applicant's arguments, see pages 13-15, filed December 29, 2008, with respect to the rejection(s) of claim(s) 1-29 and 35-41 under 35 U.S.C. 103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Kondo and Millich and further in view of Moulton et al., Chem Rev. 2001, 101, 1629 which provides motivation to combine Kondo and Millich.

#### ***Election/Restrictions***

4. Applicant's election of Group I, claims 1-29 and 35-41, in the reply filed on December 29, 2008 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).
5. Claims 30-34 are acknowledged as withdrawn.

#### ***Drawings***

6. Examiner acknowledges the drawings submitted on September 15, 2006.

#### ***Claim Objections***

7. In light of amendments made to claim 6, examiner withdraws previous objections.

***Claim Rejections - 35 USC § 112***

8. Claim 6 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
9. Claim 6 is objected to because of the following informalities: "the pore is defined as the region of a single organometallic layer surrounded by four pillar ligands". This does not describe the boundaries of a void. Appropriate correction is required.

***Claim Rejections - 35 USC § 103***

10. Claims 1-6, 8-21, 23-29, 35, 36, 38, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo et al., *Angew. Chem. Int. Ed.* 1999, 38 in view of Millich et al., *J. Phys. Chem.* 1962, 66(6), 1070 and Moulton et al., *Chem Rev.* 2001, 101, 1629.
11. Claim 1 teaches an organometallic complex structure comprising a metal ion, an organic compound capable of binding to the metal ion, a pillar ligand, and an organic polymer capable of interacting with the metal ion, where the complex structure is porous. Kondo teaches the synthesis of  $[\text{Cu}_2(\text{pzdc})_2(\text{L})]\text{xH}_2\text{O}$ , where pzdc = pyrazine-2,3-dicarboxylate, L = pyrazine (see scheme 1). The corresponding structure is porous (figure 2).
12. Kondo does not teach an organic polymer capable of interacting with the metal ion. Millich teaches using polyvinylsulfonic acid (PVSA) in the interaction of metal ions, including Cu (see page 1072, section C). One of ordinary skill in the art at the time the invention was made would have been motivated to modify the complex structure in

Kondo with the polymer taught in Millich because Millich teaches using PVSA to change the solution properties of the metal (see figure 3) and Moulton teaches using coordination polymers to guide crystal self assembly, see section II, page 1623.

Therefore, the invention as a whole would have been prima facie obvious to one of ordinary skill in the art at the time the invention was made.

13. Claims 2 and 3 include the ratio of the metal to ligand to pillar (claim 2) and add water complex (claim 3). Kondo teaches a complex structure with the ratio of 2:2:1 that is complexed to water (scheme 1).

14. Claim 4 discloses the complex structure of claim 1 has pores of a specific size arrayed regularly. Kondo teaches that pores have a specific size and are arrayed regularly (Scheme 1 and Figures 1 and 2).

15. Claims 5 and 6 describe the spatial relation of the layers to the pillar ligands (claim 5) and the pore (claim 6). Kondo teaches the same description (scheme 1 and figure 2).

16. Claim 8 describes organometallic layer structural units bridged by organic compounds and the metal ions forming dimer units. Kondo teaches the same (scheme 1 and figure 2).

17. Claim 9 describes the orientation of the pillar ligand and how it is bound to two metal ions. Kondo teaches the same (scheme 1 and figure 2).

18. Claims 10-12 describe the metal ion in detail, it being a group 6-group 12 element (claim 10), divalent (claim 11), and selected from a list which includes copper (claim 12). Kondo teaches the use of divalent copper (scheme 1).

19. Claims 13-15 describe the organic compound in detail: it is capable of bridging (claim 13), it is a heteroaromatic compound or derivative (claim 14), and it is pyrazine-2,3-dicarboxylate (claim 15). Kondo teaches the same limitations (scheme 1 and figure 2).
20. Claims 16 and 17 describe the organic compound and the pillar ligand as being either hydrophilic or hydrophobic (claim 16), and that they are either both hydrophilic or hydrophobic (claim 17, see 112 Rejections above). Kondo teaches using pyrazine and pzdc which are both hydrophilic (scheme 1 and figure 2).
21. Claims 18-20 describe the pillar ligand in detail: it is a heteraromatic compound (claim 18), it has heteroatoms at both ends (claim 19), and it is selected from the list of claim 20 which includes pyrazine. Kondo teaches using pyrazine as the pillar ligand (scheme 1).
22. Claim 21 describes the pillar ligand being capable of being expanded, contracted, or transformed. Kondo teaches using pia (see scheme 1) which can be expanded, contracted, or transformed.
23. Claim 23 discloses the pillar ligand comprises two or more organic molecules and further states properties of the organometallic complex structure of claim 1: the organic molecules can interact through  $\pi$ - $\pi$  stacking. Kondo does not elaborate on the properties of  $\pi$ - $\pi$  stacking. However, since all the components of the organometallic complex structure that is disclosed in claims 1 and 23 and which is taught in Kondo are the same, one of ordinary skill in the art would have recognized that the pillar ligands in the organometallic complex structure taught in Kondo would also have  $\pi$ - $\pi$  stacking.

24. Claims 24-26 describe the polymer used: it is ionic (claim 24), it is either cationic, anionic, or amphoteric (claim 25), and it is PVSA, Na salt (claim 26). Millich teaches using PVSA as a sodium salt to complex with copper (page 1072).

25. Claim 27 states properties of the organometallic complex structure of claim 1, the crystalline structure is either plate-like, granular, or wire-like. Kondo does not elaborate on the properties of crystalline structure. However, since all the components of the organometallic complex structure that is disclosed in claims 1 and 23 and which is taught in Kondo are the same, one of ordinary skill in the art would have known that the crystal structure of the organometallic complex structure taught in Kondo would also be either plate-like, granular or wire-like.

26. Claim 28 describes the use of the complex structure for adsorption, desorption, and arrangement of a guest. Kondo teaches using the organometallic structure for adsorption of methane (figure 4).

27. Claim 29 discloses an intended use of the organometallic structure. Kondo fails to teach using the structure for "at least one of selective adsorption and desorption of a guest and selective arrangement of a guest". However, this phrase is a statement of intended use. As to statements of intended use, MPEP 2111.02 states:

During examination, statements in the preamble reciting the purpose or intended use of the claimed invention must be evaluated to determine whether the recited purpose or intended use results in a structural difference (or, in the case of process claims, manipulative difference) between the claimed invention and the prior art. If so, the recitation serves to limit the claim. [MPEP 2111.02 (Citing In re Otto, 312 F.2d 937, 938, 136 USPQ 458, 459 (CCPA 1963)]

No structural difference can be discerned between the prior art and the instant invention.

28. Claim 35 describes the method of making the complex structure comprising mixing the metal ion, the organic compound, the pillar ligand, and the polymer. Kondo teaches all the limitations of claim 35 (see Experimental Section).
29. Claim 36 describes making the complex structure at below 50° C. Kondo teaches making an organometallic complex structure at room temperature (see Experimental Section). One skilled in the art would have known that room temperature is below 50°C.
30. Claim 38 discloses using stirring to carry out the mixing. Millich teaches stirring the solution (Experimental).
31. Claim 41 describes mixing the metal ion as a compound containing the metal ion. Kondo teaches mixing  $\text{Cu}(\text{ClO}_4)_2 \cdot 6\text{H}_2\text{O}$ , a compound containing the metal ion (see Experimental Section).
32. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo, Moulton and Millich Moulton as applied to claim 1 above, and further in view of Hou et al., U.S. Patent 6,468,657. The discussion with respect to Kondo, Moulton and Millich as set forth in paragraphs 9-30 above is incorporated here by reference.
33. Claim 7 discloses the pore sizes being capable of being changed by a stimulus. Neither Kondo nor Millich teach the size of the pores being changed by a stimulus. However, Hou teaches organic layers that associate with metals and form pores. The pore size can be altered with exposure to certain conditions including steric bulk and polarity. (Column 13 lines 22-34). One of ordinary skill in the art at the time the invention was made would have been motivated to modify the Kondo and Millich with Hou



because Hou teaches the formation of multilayered porous materials for recognition, see Hou, abstract. Therefore, the invention as a whole would have been prima facie obvious to one of ordinary skill in the art at the time the invention was made.

34. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo, Moulton and Millich as applied to claim 1 above, and further in view of Takahama et al., U.S. Patent 5,149,513. The discussion with respect to Kondo, Moulton and Millich as set forth in paragraphs 9-30 above is incorporated here by reference.

35. Claim 22 discloses the pillar ligand being capable of being expanded or contracted by a stimulus. Neither Kondo nor Millich teach the pillar being changed by a stimulus. However, Takahama teaches organic pillars expanding in the stimulus of a solvent. (Column 6, lines 28-54, column 7, lines 28-50). One of ordinary skill in the art at the time the invention was made would have been motivated to modify the Kondo and Millich with Takahama because Takahama the synthesis of a layered, porous material for adsorption, see Takahama, abstract. Therefore, the invention as a whole would have been prima facie obvious to one of ordinary skill in the art at the time the invention was made.

36. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo, Moulton and Millich in view of Uemura et al., J.Am.Chem.Soc. 2003, 125, 7814-7815. The discussion with respect to Kondo, Moulton and Millich as set forth in paragraphs 9-30 above is incorporated here by reference.

37. Claim 37 discloses the mixing ratio of the organic compound to the metal ion to be more than 20. Kondo does not teach the mixing ratio of more than 20. Uemura discloses mixing a metal ion with the organic compound in a ratio of 1:20. One of ordinary skill in the art at the time the invention was made would have been motivated to modify the Kondo and Millich with Uemura because Uemura uses self assembling polymers on transition metals, see Uemura second paragraph. Therefore, the invention as a whole would have been prima facie obvious to one of ordinary skill in the art at the time the invention was made.

38. Claims 39 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo, Moulton and Millich as applied to claim 1 above, and further in view of Anderson et al., U.S. Patent 4,818,898. The discussion with respect to Kondo and Millich as set forth in paragraphs 9-30 above is incorporated here by reference.

39. Neither Kondo nor Millich teach applying pressure to a crystal or powder. However, Anderson teaches applying pressure or molding crystals (column 7, lines 30-35). It would have been obvious to one skilled in the art that pressure could be applied via fingers. One of ordinary skill in the art at the time the invention was made would have been motivated to modify Kondo and Millich with Anderson because Anderson uses organometallic lattice forming compounds capable of forming cavities (Anderson: column 3, lines 38-68; column 4, lines 55-61). Therefore, the invention as a whole would have been prima facie obvious to one of ordinary skill in the art at the time the invention was made.

***Response to Arguments***

40. Applicant's arguments filed on December 29, 2008 have been fully considered but they are not persuasive.

41. Regarding Applicant's argument that claim 6 is not indefinite, Applicant's argument is not persuasive. Taken together, claim 5 and claim 6 describe four parallel pillar ligands and a perpendicular organometallic layer. Claim 6 defines a *pore* based on the four pillar ligands. However, the four pillar ligands can define a column of void, but do not define a top or bottom of the column. Presumably, the organometallic layer would do this, however, neither claim 5 nor claim 6 define where the organometallic layer is in relation to the pillar ligands. The organometallic layer could be at the top, bottom or somewhere in the middle of the four pillar ligands. Without knowing where the organometallic layer is in relation to the pillar ligands, a pore cannot be defined.

42. In response to applicant's argument that there is no suggestion to combine the references Kondo and Millich, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

43. In this case, Applicant argues that no motivation to combine Millich and Kondo exists because Millich relates to coacervation induced by heavy metal ions and Kondo discloses an organometallic complex structure. Applicant's argument is not persuasive.

44. Applicant is directed to the reference Moulton et al., Chem Rev. 2001, 101, 1629. One of ordinary skill in the art would recognize that Kondo forms a repeating, crystalline organometallic complex structure and is concerned about controlling the characteristics of the structures of the network (see figure 2; first paragraph, page 142) and would therefore look to basic review articles such as Moulton, which teaches supramolecular isomerism and polymorphism in complex networks (see abstract). Moulton then teaches using coordination polymers to guide crystal self assembly (see section II, page 1623). One of ordinary skill in the art would then look to coordination polymers, of which "an organic polymer capable of interacting with the metal ion" (instant application, claim 1) must be. One of ordinary skill in the art would recognize that polymers that interact with heavy metal ions in coacervation would be coordination polymers. Moreover, coacervation polymers would be the type of coordination polymers necessary to guide self assembly because they help separate out components into different phases. Millich teaches coacervation polymers to coordinate metal ions (see page 1072, section C). Therefore, Moulton gives motivation for the combination of Kondo and Millich.

45. Hou, Takahama, Uemura, and Anderson are used as teaching references, and not to show motivation for the combination of Kondo and Millich.

46. Applicant's argument that "none of the cited references disclose or suggest the above discussed effects achievable in the presently claimed invention" is persuasive,

however, the new reference, Moulton, overcomes this argument. It is noted that the features upon which Applicant relies (i.e., controlling crystal growth and effectively stabilizing the structure) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

### ***Conclusion***

47. A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to **ROBERT C. BOYLE** whose telephone number is (571)270-7347. The examiner can normally be reached on Monday-Friday, 9:00AM-5:00PM Eastern.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vasu Jagannathan can be reached on (571)272-1119. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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Examiner, Art Unit 1796

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